Emerging Issues with Process Hazard Analyses

Mary Kay O'Connor Process Safety Center
Process Safety Management/
Risk Management Program —
Current Issues and Updates

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Key Issues to Discuss

- Emerging Issues with PHAs
  - New risk issues may be applicable to PHAs, so the roles may be changing
  - A new approach to PHAs is recommended to address the new concerns
  - The identification and analysis of hazards must be founded in a quality process for consistency, accuracy, and manageability

PHA Strengths

- Employee involvement
- Creative exercise with team interaction
- Knowledge applied most efficiently
- Can be thorough if done to the proper level

PHA Limitations

- Results are dependent on the amount and quality of effort invested
- Possible for analyst bias and knowledge
- Inaccurate input data and information will cause inaccurate results
- Can be time consuming & resource intensive

PHA Quality Issues

- Timing of the studies
- Proper methodology employed
- Completeness
- Team makeup and team leader qualifications
- Followup system for PHA recommendations

Common Missing Issues with PHAs

- Did not fully document hazards of the process
- Did not consider most serious credible hazards
- Did document all safeguards
- Did not evaluate and rank risks consistently

Common Missing Issues with PHA Action Items

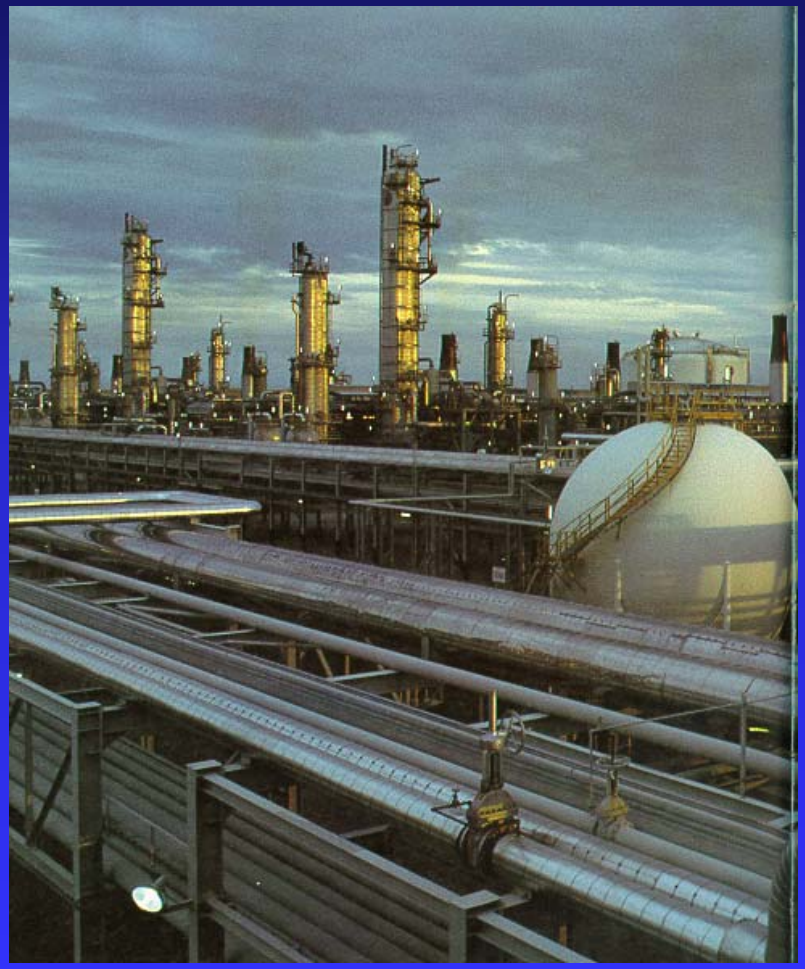
- Slow to closeout PHA recommendations
- No formal decision-making process

- Note – Could be building a liability of unresolved action items

How to improve?

- Establish a common method for analysis
- Educate the employees who will be involved in the process on the principles and the process to be followed
- Establish guidance including checklists
- Establish QA procedures
- Diligence in followup

Scope of PHA Studies is Expanding



Expanding Scope of PHAs

- The PHA format is ideal for addressing other emerging risk issues, so new ways of conducting PHAs may be forthcoming
- Companies need to commit to a proactive approach to these issues
- Make employees aware of the principles and train on a method to apply them
- All this adds to increasing demands for PHA teams and PHA coordinators

PHA Scope:

- Need to address:
  - Process safety
  - Reliability
  - Operability
  - Public safety
  - Environmental safety

Need to address:

- Accidental release hazards of the process
  - Mechanical failure
  - Management systems failures
  - Human errors in operation, maintenance
  - External events
  - Facility siting

Security Hazard Assessments

Need to address:

- Intentional release hazards of the process
  - Sabotage
  - Terrorism
  - Civil unrest
  - War
  - Crime
  - Theft
  - Value chain disruption

Human Factors

AcuTech Human Factors Definition

- Human factors in process safety refers to the (positive and negative) managerial approaches and technical systems that influence human behavior and process safety incident experience

Human Error

- Majority of incidents
- Least analyzed and understood
- Greatest impact can be made by focusing on this area
- PHAs are a natural approach to help address the issues

How to Reduce Human Error

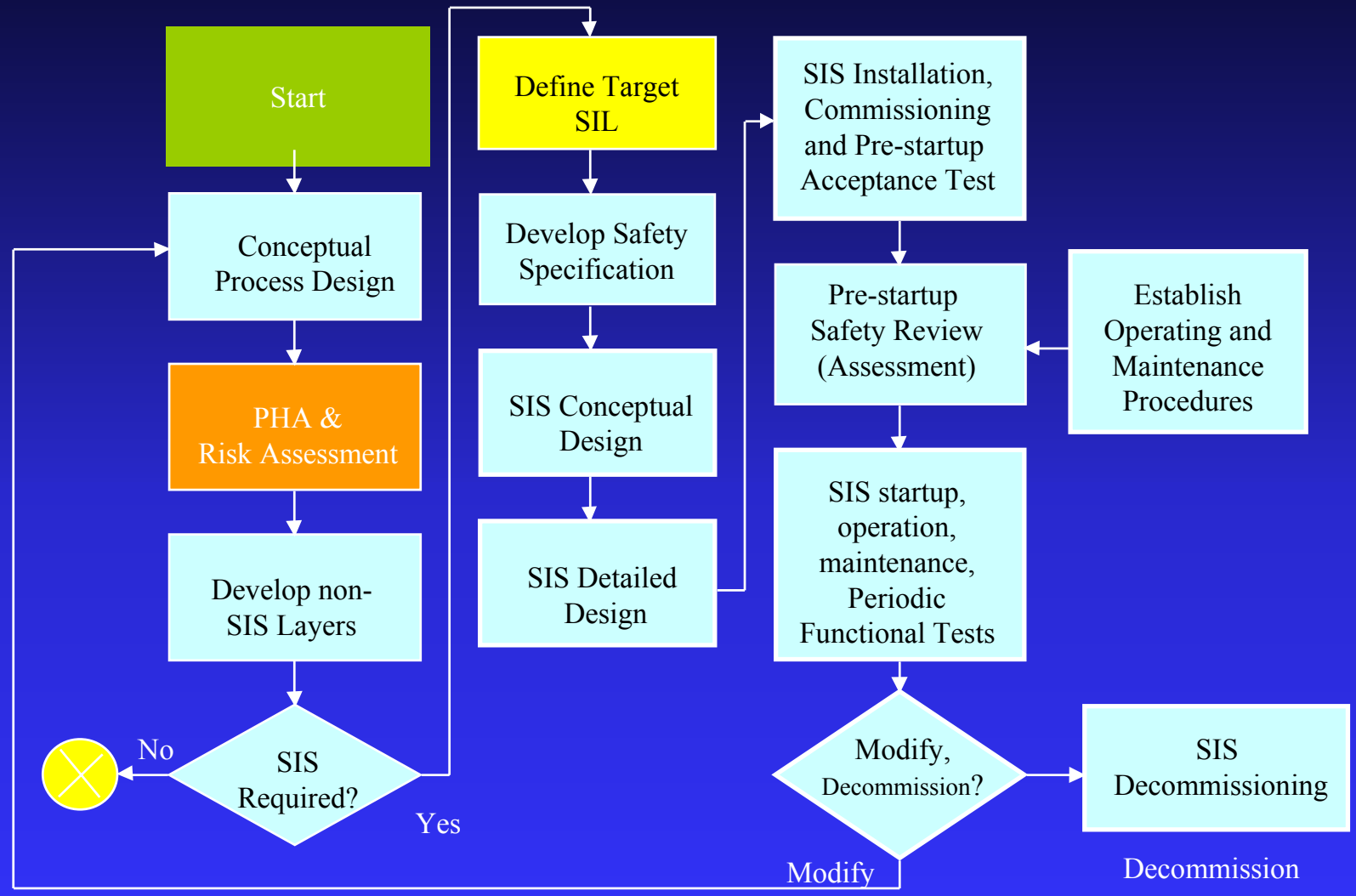
- Incorporate more human factors considerations into all PHA studies, including:
  - design considerations
  - operating practices
  - management practices
  - and needed improvements in the work environment
- Conduct special human factor task-based analyses where justified based on higher risk
- The key objective - *to reduce the number and likelihood of situations to produce error.*

AcuTech HF Risk Screening Process

- Step 1 - Identify Candidate Systems
- Step 2 – Consequence Screening
- Step 3 – Acceptable Risk Determination
- Step 4 – Latent Conditions Review
- *Step 5 – Hazard Identification (PHA)*
- Step 6 – Risk Screening
- Step 7 – Acceptable Risk Determination
- Step 8 – Identify Risk Reduction Opportunities
- Step 9 – Risk–Based Prioritization
- Step 10 – Risk Reduction

Safety Instrumented System Standards Per ANSI/ISA S84.01

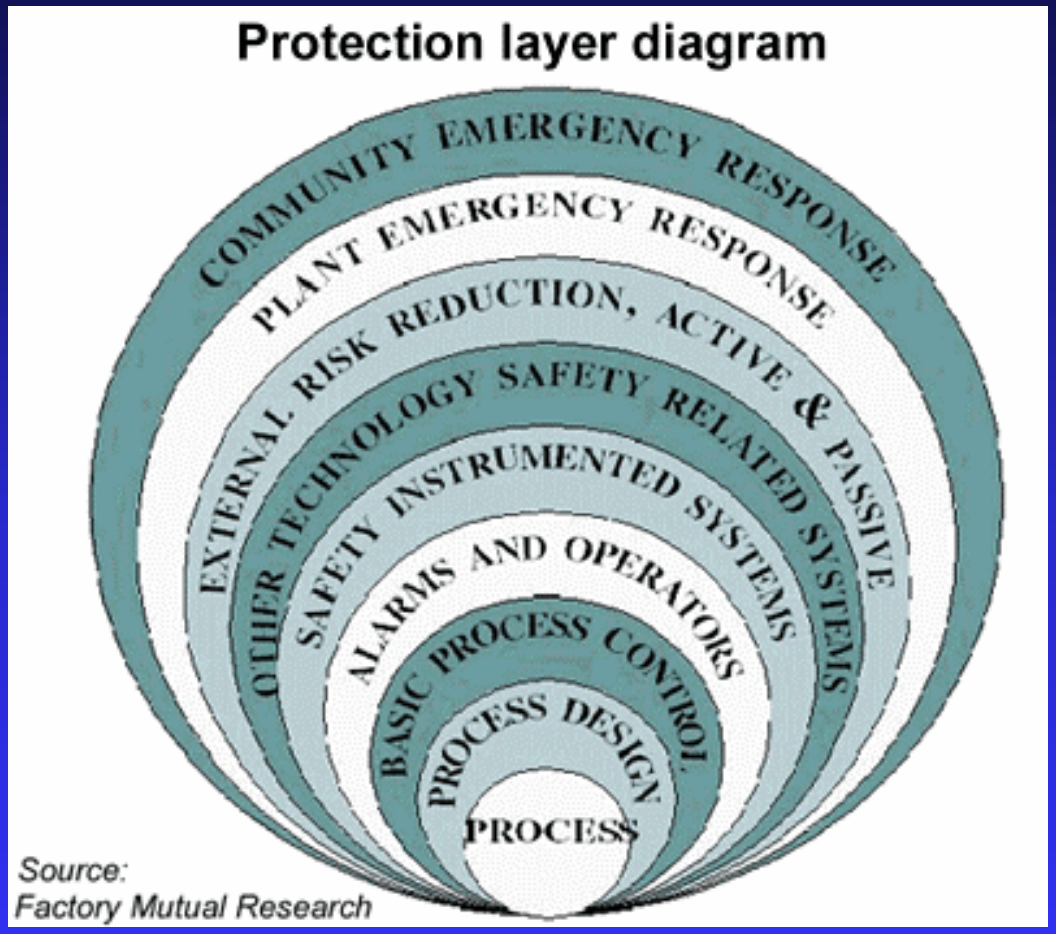
The ISA S-84.01 Safety Life Cycle



AcuTech Risk Ranking Matrix For SIL

	Likelihood 1	Likelihood 2	Likelihood 3	Likelihood 4	Likelihood 5
Severity 1	Cell #1 *3-1* *SIL 3*	Cell #4 *3-2* *SIL 3*	Cell #7 *2-3* *SIL 2*	Cell #9 *2-4* *SIL 2*	Cell #17 *1-5* *SIL 1*
Severity 2	Cell #2 *3-2* *SIL 3*	Cell #5 *3-4* *SIL 3*	Cell #8 *2-6* *SIL 2*	Cell #15 *1-7* *SIL 1*	Cell #22 *1-8* *SIL 1*
Severity 3	Cell #3 *2-3* *SIL 2*	Cell #6 *2-6* *SIL 2*	Cell #13 *1-7* *SIL 1*	Cell #16 *1-8* *SIL 1*	Cell #23 *1-9* *SIL 1*
Severity 4	Cell #10 *1-4* *SIL 1*	Cell #12 *0-7* *OPT*	Cell #14 *0-8* *OPT*	Cell #20 *0-9* *OPT*	Cell #24 *0-10* *OPT*
Severity 5	Cell #11 *0-5* *OPT*	Cell #18 *0-8* *OPT*	Cell #19 *0-9* *OPT*	Cell #21 *0-10* *OPT*	Cell #25 *0-10* *OPT*

Layers of Protection Analysis



LOPA

- Analyze the effectiveness and reliability of the layers of protection
- Foundation is a PHA
- Can the existing PHA studies be relied on for this analysis, i.e., are they complete?

Chemical Security

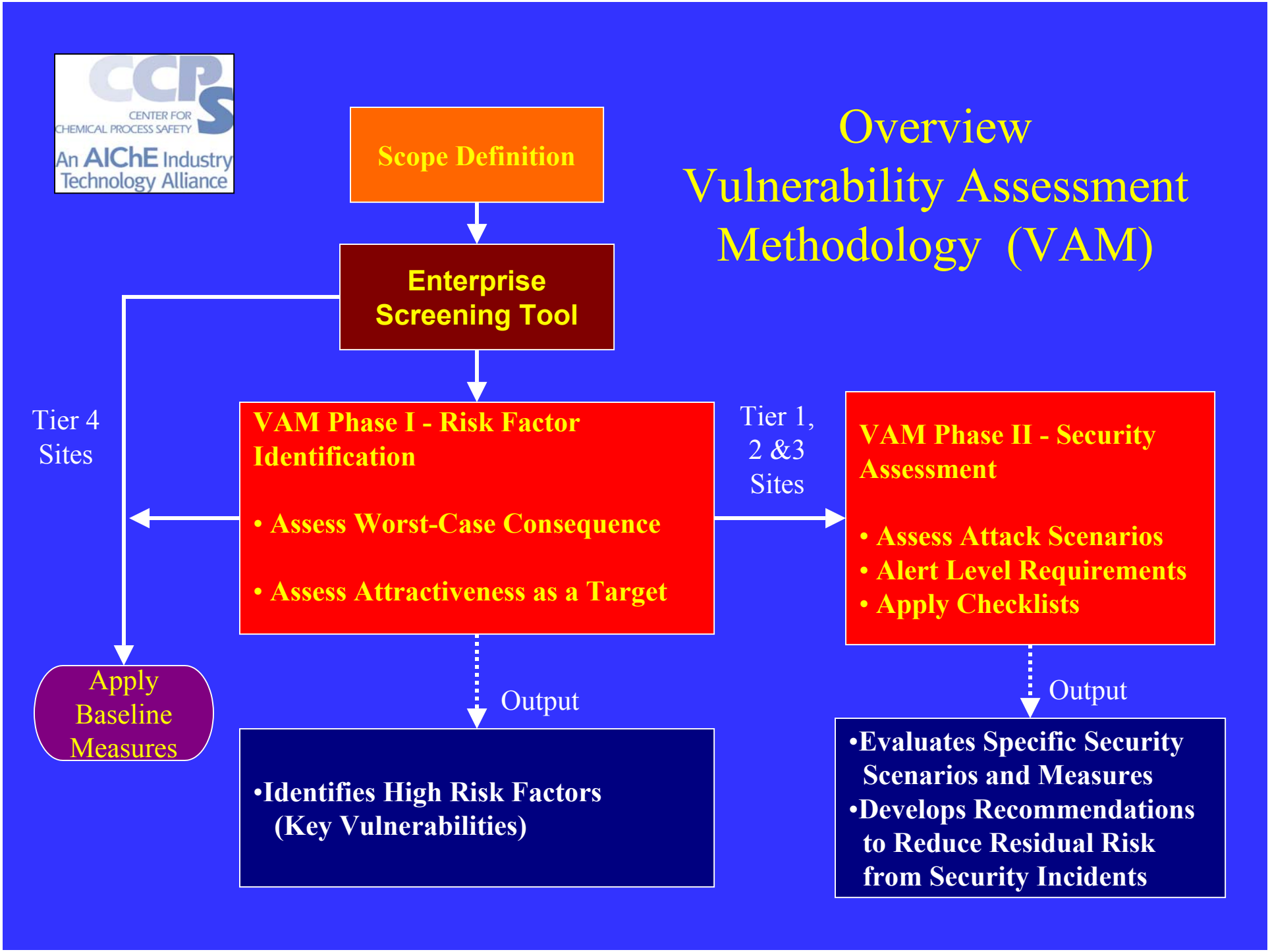
CCPS Chemical Facility Security Risk Assessment Program

- CCPS is developing a process for conducting security hazard assessments
- PHA-type assessment as a tool
- Challenge - Routinely conduct within the PHA or as a separate study?

Managing a Company's Security Risk

- Assure all sites meet baseline security requirements
- Prioritize sites for detailed security assessment
- Identify key high risk factors for each site
- Assess specific *security AND hazard reduction measures* based on high risk factors
- Implement the most effective measures
- Repeat

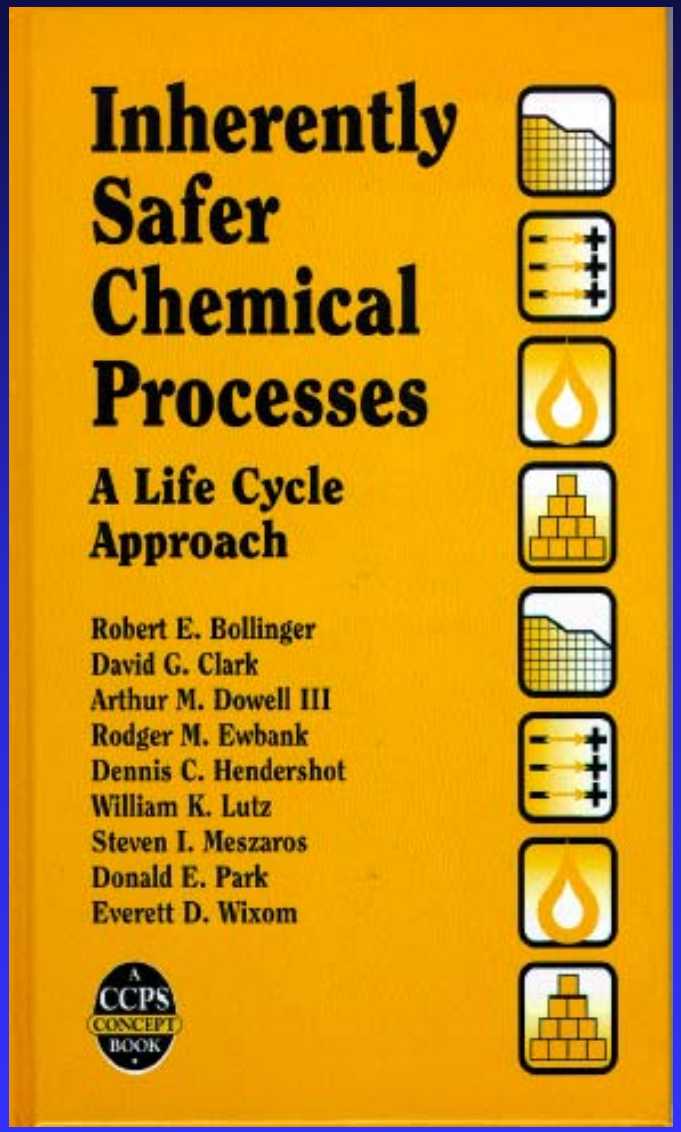
Manage Our Security Risk


CENTER FOR CHEMICAL PROCESS SAFETY
An AIChE Industry Technology Alliance
Scope Definition
Enterprise Screening Tool
Overview
Vulnerability Assessment
Methodology (VAM)
Tier 4 Sites
VAM Phase I - Risk Factor Identification
• Assess Worst-Case Consequence
• Assess Attractiveness as a Target
Tier 1, 2 &3 Sites
VAM Phase II - Security Assessment
• Assess Attack Scenarios
• Alert Level Requirements
• Apply Checklists
Apply Baseline Measures
Output
•Identifies High Risk Factors (Key Vulnerabilities)
Output
•Evaluates Specific Security Scenarios and Measures
•Develops Recommendations to Reduce Residual Risk from Security Incidents

Inherently Safer Systems

American Institute of Chemical Engineers
Center for Chemical Process Safety
Concept Book (1996)

'The Gold Book'



Process Risk Management Strategies

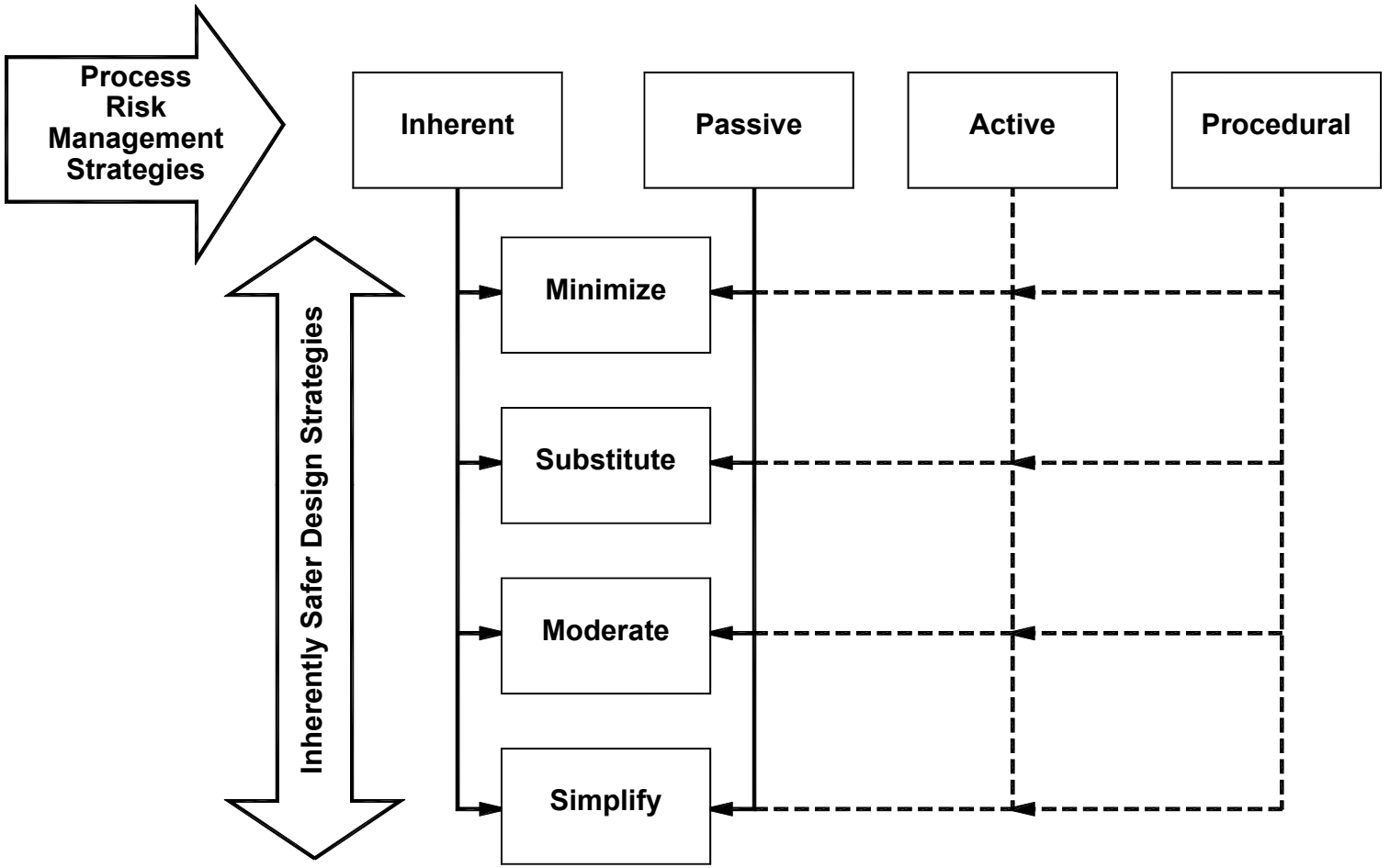
- Inherent
  - *Eliminate or modify the hazard and/or risk* by employing one of four strategies of minimization, substitution, moderation, simplification
- Passive
  - *Minimize the hazard* by process and equipment design features which reduce either the frequency or consequence of the hazard without the active functioning of any device.
- Active
  - *Using controls, safety interlocks, and emergency shutdown systems* to detect and correct process deviations.
- Procedural
  - Using operating procedures, administrative checks, and emergency response to *prevent incidents* or to *minimize the effects* of an incident.

Source: CCPS

Inherently Safer Design Strategies

Strategy	Example
Minimize	Use smaller quantities; eliminate unnecessary equipment; reduce size of equipment or volumes processed.
Substitute	Replace material with a less hazardous substance.
Moderate	Use less hazardous conditions, a less hazardous form of material or facilities which minimize the impact of a release.
Simplify	Design facilities which eliminate unnecessary complexity and make operating errors less likely.

INHERENTLY SAFER SYSTEMS STRATEGIES



Source: Fig 2.2, CCPS

Inherent Safety Approach for PHAs

- Develop a four strategy checklist for PHAs:
  - Substitution
  - Moderation
  - Minimization
  - Simplification
- Combine this philosophy training for PHA team members.

Inherently Safer Systems Matrix

Inherent Safer Design Strategies	Process Risk Management Strategies			
	Inherent (1)	Passive (2)	Active (3)	Procedural (4)
Minimize	MIN1	MIN2	MIN3	MIN4
Substitute	SUB1	SUB2	SUB3	SUB4
Moderate	MOD1	MOD2	MOD3	MOD4
Simplify	SIM1	SIM2	SIM3	SIM4

Proposed Chemical Security Act of 2001 Would Mandate Inherent Safety

- Use less hazardous substances or benign substances
- Use a smaller quantity of covered substances
- Reduce hazardous pressures or temperatures
- Reduce the possibility and potential consequences of equipment failure and human error
- Improve inventory control and chemical use efficiency
- Reduce or eliminate storage, transportation, handling, disposal, and discharge

Best Application of ISS Principles

- Inherent Safety is best applied by those knowledgeable of the process
- We recommend that ISS be considered as an integral part of the PHA process
- Teams should be given the flexibility to chose an appropriate methodology

Why Aren't Inherently Safer Design Practices Being Used to Their Maximum Advantage?

- Lack of an accepted inherent safety hazard analysis approach
- The lack of basic inherent safety knowledge of many of the teams who are conducting PHAs
- Perception that inherent safety is impractical

Conclusions and Recommendations

- PHAs are the foundation of a process safety program – You can't manage what you don't understand.
- Quality-minded programs need to be organized and maintained.
- PHAs may be used to address a wide variety of emerging risk issues
- Guidance should be provided to PHA team on technical approaches and how to integrate the new issues

Resource for Further Information

www.acusafe.com